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Correlation Between Changes in Biochemical Roots of Wheat (*Triticum durum desf*) and Stress Induced by Some Regimes Fertilizer NPK

[1]Bouchelaghem Sabrina, [1]Djebar Mohammed-Réda, [2]Rouabhi Rachid,
[1]Ramdani Kamel and [2]Berrebbah Houria

[1]Laboratory of Cell Toxicology. BadjiMokhtar University Annaba, 23000, Annaba, Algeria
[2]Nature and life Sciences department, E.Sc. and N.L. Sc. Faculty, Tebessa University, Algeria

Abstract: We studied the physio-biochemical parameters of the wheat roots (*Tritium durum Desf*), in the water content (TE), total protein levels (TPL), carbohydrate (TCH) proline (TP), Malondialdehyde (MDA), on the one hand and enzyme activities catalase (CAT) and ascorbate-Perroxydase (APX) on the other hand, with four fertilizer regimes: 0.5: 01: 01, 0.5: 02: 01, 0.5: 03: 01 and 0.5: 04: 01g/propagator NPK. Our results show that the maximum content of water is obtained with the regime. 0.5: 01: 01g/propagator NPK. Total protein and the average maximum with 0.5 proline proved: 02: 01, 0.5: 03: 01 and 0.5: 04: 01g / hotbed of NPK. It records the total carbohydrate highest respectively 0.5: 02: 01; 0.5: 03: 01 and 0.5: 04: 01g/hotbed NPK. The activities of enzymes catalase (CAT), ascorbate peroxidase (APX), were measured simultaneously with the average rates of malondialdehyde (MDA) and the parameters as indicators of cellular disorders. The results obtained show that the schemes 0.5: 02: 01 and 0.5: 03: 01 and 0.5: 04: 01g/Propagator NPK are capable of generating oxidative stress expressed through stimulation of enzyme activity CAT and APX and resulted in a significant increase in the average rate of MDA. This does not seem to be the case for regime 0.5: 01: 01g/Propagator NPK. Our study thus demonstrates the existence of a positive correlation between water content, total protein, carbohydrate, proline, MDA, CAT and APX in roots of wheat with three fertilizer regimes 0.5: 02: 01; 0.5: 03: 01 and 0.5: 04: 01g/Propagator NPK. Our results suggest a possible apparent toxicity may be associated with some phosphate fertilizers.

Key words: NPK · Wheat · Fertilizer · Toxicity · Roots

INTRODUCTION

Plants collect the mineral soil to produce organic compounds. It is established that several components are necessary for normal functioning of the biochemical machinery of the plant. Nutrients should be present in a form assimilable to the plants can absorb. Mineral fertilizers are intended to provide the necessary complement to the supply of soil to meet the physiological needs of plants for optimum growth and development. Today only 17 chemical elements are considered essential because of their importance for growth and development of plants. Among these 03 are considered major, it's nitrogen, phosphorus and potassium, NPK) [1]. Wheat, like most plants cannot absorb nitrogen from the air necessary for the synthesis of amino acids. Excess, although rarely toxic, may promote excessive growth of stems and leaf development at the expense of fruit. Structural component of nucleic acids, phosphorus is essential for the process of flowering, seed set or fruit plants, especially cereals. It is necessary for the synthesis of all cellular membranes of plants [2]. Thus the importance of NPK fertilizer is well recognized [3-7]. Parallel to this research, other authors have highlighted the adverse effects of NPK treatments on cellular metabolism of plants and especially the stress produced by these elements [8-10]. In this sense also that our study is undertaken, our objective concerns the search for a possible correlation may exist between changes in physio-biochemical parameters and different fertilizer regimes in the roots of wheat.

Corresponding Author: Bouchelaghem Sabrina, Laboratory of Cell Toxicology. BadjiMokhtar University Annaba. 23000, Annaba, Algeria, E-mail: r_rouabhi@yahoo.fr.

Analytical Techniques:

Determination of Average Water Content: The average moisture content of wheat roots are determined by the method of [11].

Determination of the Average Protein Content: Total proteins were determined by the method of [12] this method uses the BSA (Bovine Serum Albumin) as standard.

Determination of the Average Content of Soluble Sugars: The total soluble sugars were assayed by the method of Burnett and Schield (1960), sugars are extracted in sulfuric acid in the presence of anthrone. The assay is then performed at the wavelength λ = 585 nm.

Determination of the Average Content of Proline: Proline is determined by the method of [13].

Determination of the Average Rate of MDA: The concentration of MDA was determined as shown in [14].

Enzyme Assay

Determination of APX: Ascorbate peroxidase activity wasmeasured according to the protocol of [15]. The APX activity was presented as nmol/min/mg of protein.

Determination of Catalase Activity (Cat): We used for measuring the activity of catalase (CAT) The Method of [16].

RESULTS

Treatment effects of wheat roots by different regimes of NPK fertilizers on moisture, total protein and soluble sugars. The results of treatment effects of wheat roots by different regimes of NPK fertilizers on the average water content, average total sugar and mean levels of total proteins are summarized in the following table 1.

It is found that the maximum water content is obtained with the system (0.5: 01: 01g/ger.) With 97% / g.PF followed by the second system while the lowest values are recorded with plans NPK (0.5: 03: 01 and 0.5: 04: 01g/prop.). Meanwhile, the highest contents of total sugars and total protein were recorded with the last three diets (P = 2, 3 and 4). Thus we see that diets rich in phosphate tend to cause an increase in total sugars and proteins.

Treatment effects of wheat roots by different regimes of NPK fertilizers on the levels of proline. Assay results of changes in levels of proline are shown in Figure 1.

This shows that the proline content increased proportionally with the systems used especially with the amount of phosphate. Indeed, the amounts identified regime 0.5:04:01 g/prop. is almost 4 times higher than that registered with the scheme the lowest phosphate. The increase in this parameter generally reflects a state of stress bodies.

Treatment effects of wheat roots by different regimes of NPK fertilizer on enzyme activity Catalase (CAT). The results of changes in CAT enzyme activity are shown in Figure 2.

This figure shows that CAT activity increases with the nature of the diets used, in fact, this activity peaked with the regime 0.5: 04: 01g/prop. NPK. This observation reflects a real characteristic detoxification activity of the enzyme very clear at the phosphate-rich diet.

Treatment effects of wheat roots by different regimes of NPK fertilizer on enzyme activity-ascorbate peroxidase (APX). The results of changes in APX enzyme activity are shown in Figure 3.

Treatment of wheat roots by the regime the lowest phosphate (0.5:01:01 g/prop.) saves APX activity close to 0.05 nmol/min/mg.Prot. The plan gives high amount of phosphorus the highest APX activity (6 times those of the regime in the lower phosphate). In this case we can also be explained by a phenomenon of stress induced by the three diets high in phosphate.

Table 1: Effect of treatment of the roots of *Durum wheat* by different regimes of NPK on moisture, total sugars and total protein.

Regime NPK (g/propagator)	0.5: 01: 01	0.5: 02: 01	0.5: 03: 01	0.5: 04: 01
Water (%/g.FW)	97	88	74	69
Total carbohydrate (µg/gFW)	60	74	121	162
Total protein (µg/gFW)	10.2	11.6	15.2	18.6

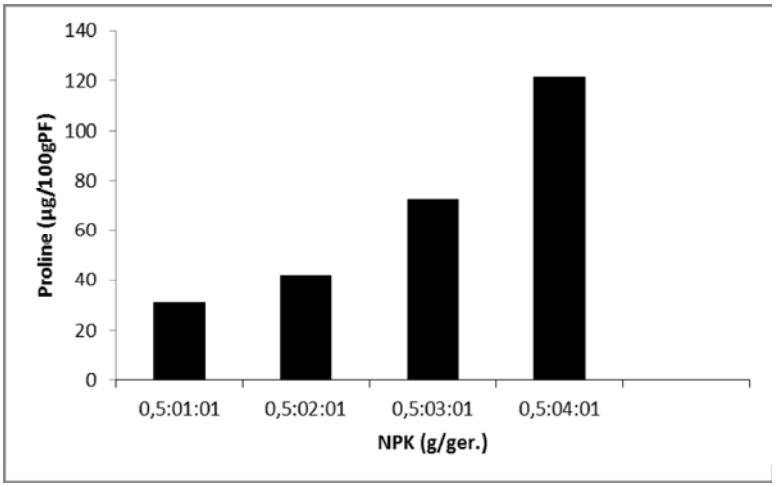

Fig. 1: Effect of treatment of the roots of durum wheat by different regimes of NPK on average rates of proline.

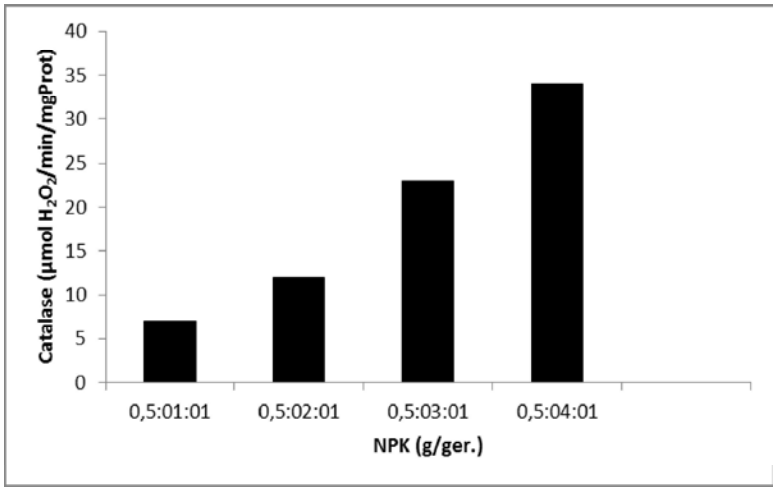

Fig. 2: Effect of treatment of the roots of durum wheat by different regimes of NPK on changes in levels of catalase.

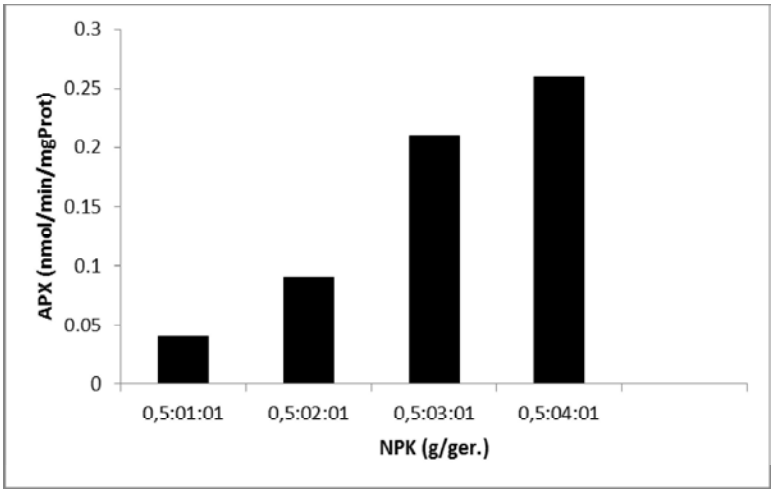

Fig. 3: Effect of treatment of the roots of durum wheat by different regimes of NPK on the variations of the levels of ascorbate peroxidase.

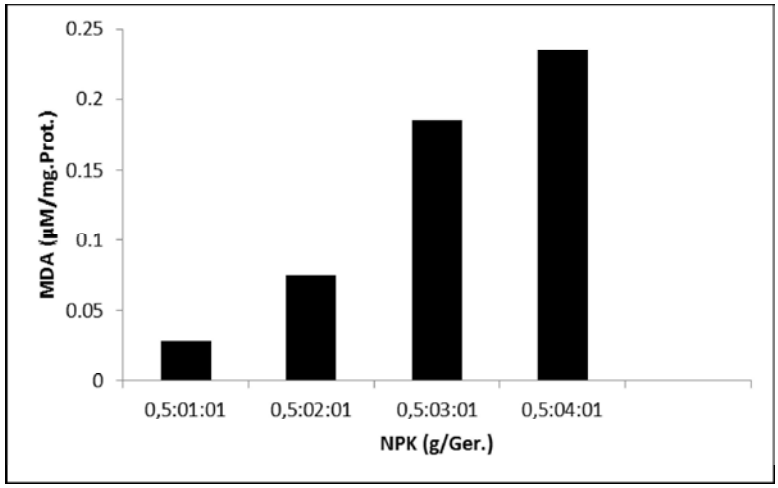

Fig. 4: Effect of treatment of the roots of durum wheat by different regimes of NPK on changes in average rates of MDA.

Treatment effects of wheat roots by different regimes of NPK fertilizers on changes in average rates malonyldialdehyde (MDA). The results of changes in average rates of MDA recorded as a function of fertilizer regimes used are shown in Figure 4

In this figure, the regime NPK fertilizer 0.5: 01: 01 gives a tau of 0.028 microM of MDA/mg.Prot. This rate is multiplied by a factor of 5 with the plan of 0.5 NPK: 04: 01g/ger. This very high rate of MDA reflects a very high activity of lipid peroxidation products by the stress state of roots treated with the other 3 schemes of NPK fertilizer.

DISCUSSION

Wheat is one of the most important vegetable crops worldwide. This production is very low in the Maghreb countries due to many factors limiting the production of wheat, such as fertilizers. In this sense, moreover, that supplements the nutritional balance of this plant are needed. Thus these nutrients play an important role in the production quantity and quality of wheat [1]. But adequate amounts are still difficult to determine and recent research [10] highlight the adverse effects of NPK fertilizer. Our results show that excess phosphate in the schemes used tends to cause an increase in moisture, proteins and sugars. Several research studies report similar findings; [17] observed that the gradual increase of NPK fertilizer causes a gradual increase in crude protein, total sugars, reducing sugars, starch and soluble carbohydrates. It is the same for the results reported by [18]. Meanwhile, our results show that the excess phosphate in the schemes used to cause increased levels of proline followed by a stimulation of enzyme markers of stress such as catalase, ascorbate peroxidase and finally the rate of MDA. MDA, product of peroxidation of membrane lipids, is considered a marker of oxidative damage and an increase in concentration indicates that the induction of oxidative stress was successful. Increased concentrations of MDA detected in wheat roots in large part can be explained by higher lipid peroxidation within the root cells. These observations suggest that peroxidation of lipids spread at the plasma membrane. The APX activity in wheat roots subjected to oxidative stress was significantly higher than in the group receiving (scheme 0.5: 01: 01g/prop), which suggests that detoxification activity of hydrogen peroxide by the enzyme is highlighted [14]. Furthermore, CAT activity was significant in the three high phosphate diets. Our results show that the increase in CAT activity is associated with increased concentrations of MDA.

Our results show that diets rich in phosphate fertilizers are capable of inducing oxidative stress reflected by the high activity of CAT, APX and high levels of MDA. They show the existence of a positive correlation between changes in these markers and the apparent toxicity of diets rich in phosphate fertilizers. It would be interesting to determine if there is a correlation between an increase in antioxidant capacity and better chances of survival or faster growth when wheat plants are exposed to stress.

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